

RISK FACTORS FOR THE EMERGENCE/ RE-EMERGENCE OF LAGOMORPHS' CALICIVIRUS INFECTIONS

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Abstract

Two distinct *Calicivirus* infections in lagomorphs have been described: rabbit haemorrhagic disease (RHD) and European brown hare syndrome (EBHS). From their first report, in the 1980s, and until now several European countries have been reported outbreaks of both diseases. Due to high economic and ecologic impact on rabbit breeding and wildlife, RHD and EBHS have been included on the list of notified diseases to OIE by Member Countries. RHD is a highly contagious and acute fatal disease of the European rabbit (*Oryctolagus cuniculus*), while EBHS is a disease with similar pattern but described only in hares (*Lepus europaeus*). From 1980s, RHD occurred in almost all Europe, but EBHS only in Sweden, Italy, Belgium, Britain, Croatia, Finland, Austria, Spain, Poland, Switzerland and Slovakia. In this paper were analysed the risk factors of emergence for RHD and EBHS in Europe. The risk factors associated belong to three main determinants: (1) the virus; (2) the host, and (3) the environment. The main virus risk factor means to be the high resistance of RHD and EBHS viruses in the environment (at least 3 months). The highest host risk factor associated with the emergence or the re-emergence of both diseases is the size of susceptible rabbit/hare population (naive). Rabbit's environment risk factors for RHD/EBHS emergence or re-emergence mean to be the amount of infectious sources on the area: number of infected host animals, number of passive carriers: insects, rodents, birds and other animals (the viruses can spread by direct and indirect contact). Based on data before, we estimate the emergence/re-emergence of RHD and EBHS in European countries may occur if the receptive rabbit/hare population will grow into an area with poor surveillance/monitoring program of lagomorphs' *Caliciviruses* and a high density of passive carriers.

Key words: rabbit haemorrhagic disease, European brown hare syndrome, epidemiology, rabbit diseases.

INTRODUCTION

Two distinct *Calicivirus* infections in lagomorphs have been described: rabbit haemorrhagic disease (RHD) and European brown hare syndrome (EBHS).

RHD is a highly contagious disease of wild and domestic European rabbits (*Oryctolagus cuniculus*), older than 2 months, with mortality around 70-90%. It is characterized clinically by neurological and respiratory signs, apathy and anorexia and pathologically by disseminated vascular coagulation lesion in all tissues and liver necrosis (Barbieri et al., 1997; OIE, 2010). From their first report, in the 1980s, and until now several European countries have been reported outbreaks of both diseases.

First outbreak of RHD occurred in an Angora rabbits farm located in Jiangsu Province of China, in the winter of 1983 (Xu and Chen, 1989). No one knows the exact origin of highly pathogenic rabbit *Calicivirus*, but is suspected to have come from European rabbit populations in the former German Democratic Republic (Cooke, 2002).

Over time, many names were used for description of RHD: viral septicaemia, viral haemorrhagic pneumonia, rabbit fever, rabbit plague, and rabbit calicivirus disease (Xu and Chen, 1989; Sheng et al., 1985; Pu et al., 1985; Chen and Zeng, 1986).

Soon after onset, RHD has spread across the globe, and several countries from Europe, Asia, Africa, America and Oceania reported outbreaks and became endemic (OIE, 2008).

In less than twenty years, researchers identified several RHDV isolates, but all of them included in one serotype with two distinct subtypes or antigenic variants: RHDV and RHDVa (Capucci et al., 1998; Schirrmeyer et al., 1999).

EBHS is a highly contagious disease of hares (*Lepus europeus*) and Irish hares (*Lepus timidus*), produced by distinct leporidae calicivirus but with similar signs and lesions as RHD (Capucci et al., 1991, 1995; Eskens and Volmer 1989; Lavazza and Vecchi, 1989). The main signs are the blending of lungs and trachea, pulmonary edema, necrotic hepatitis and high mortality (DiGiacomo and Maré, 1994; Wibbelt and Frolich, 2005). The disease is known as wild rabbit's viral hepatitis, acute necrotizing hepatitis and acute hepatitis (Lenghaus et al., 2001).

The disease was first described in 1981, in Sweden (Gavier-Widén and Mörner, 1991), but the presence of a wild rabbit hemorrhagic syndrome was signalled five years earlier by hunters in UK (Duff et al., 1994). The origin of first case remained unknown. Two hypotheses of EBHSV origin have formulated: due to a mutation previously suffered by a non-pathogenic leporidae calicivirus or by importing South American *Sylvilagus* rabbits infected with non-pathogenic leporidae calicivirus for them, but extremely virulent for European brown hare rabbits (Capucci et al., 1996, 1997).

Due to high economic and ecologic impact on rabbit breeding and wildlife, RHD and EBHS have been included on the list of notified diseases to OIE by Member Countries (OIE, 2010).

RHD is a highly contagious and acute fatal disease of the European rabbit (*Oryctolagus cuniculus*), while EBHS is a disease with similar pattern but described only in hares (*Lepus europaeus*).

From 1980s, RHD occurred in almost all Europe, but EBHS only in Sweden, Italy, Belgium, Britain, Croatia, Finland, Austria, Spain, Poland, Switzerland and Slovakia has been reported (OIE, 2010).

In this paper were analysed the risk factors of emergence for RHD and EBHS in Europe.

MATERIALS AND METHODS

In order to evaluate the risk factors of emergence for RHD and EBHS in Europe, we reviewed 21 scientific papers. The literature survey take in consideration the role of virus, host and environment in the epidemiology of *Calicivirus* infections in lagomorphs.

RESULTS AND DISCUSSIONS

The role of virus in emergence of RHD/EBHS

Rabbit caliciviruses are high resistant to harsh environmental conditions, especially embedded in organic materials (Abrantes et al., 2012). RHDV was isolated in rabbits carcasses maintained three months in environmental conditions (McColl et al., 2002; Henning et al., 2005). RHDV directly exposed to environmental conditions is infectious up to 30 days (Henning et al., 2005). Also, the viruses are keeping their infectiousness at least 7 months in organ extracts stored at 4°C, 3 months at room temperature, 20 days at 22°C in decaying carcasses, and 2 days at 60°C in organ extracts, 225 days at 4°C (Smid et al., 1989; McColl et al., 2002; OIE, 2013).

Identification and characterisation of a non-pathogenic calicivirus related to RHDV rise the question if the populations of rabbits infected with non-pathogenic calicivirus has a lower risk of RHD emergence (Capucci et al., 1996, 1997).

The high resistance of rabbit caliciviruses in the environment is the main virus risk factor and new outbreaks of RHD/EBHS could break out after extended delays (Henning et al., 2005).

The role of rabbit and hare in emergence of RHD/EBHS

RHDV causes a severe, systemic disease in European rabbits (*Oryctolagus cuniculus*), older than 3 months of age (Xu and Chen, 1989), and EBHSV causes a similar disease in European hares (*Lepus europeus*) and Irish hares (*Lepus timidus*) (Capucci et al., 1991; Lavazza et al., 1996; Wibbelt and Frolich, 2005).

The risk of RHD/EBHS emergence in wild rabbit populations is related to the proportion of susceptible rabbits in the area (Henning et al., 2005). Also, the population dynamics and spatially and genetically structure of host populations proved to influence the emergence

of RHD (Calvete C., 2006; Fouchet et al., 2009).

The breeding season, when the proportion of receptive rabbits is higher, play a role upon geographic and seasonal variation of RHD in rabbit populations (Mutze et al., 2008).

The highest risk factor host associated with the emergence or the re-emergence of both diseases is the size of susceptible rabbit/hare population (naive).

The role of environment in emergence of RHD/EBHS.

RHD/EBHS outbreaks have geographic and seasonality variance attributed to climate variables (Cooke and Fenner, 2002)

The temperature and humidity variation influence the density and activity of vector insects (Mutze et al., 2002). Parasites proved to play a role in the diffusion of pathogens infecting hares in wild rabbit populations (Tizzani et al., 2002); flying insects are mechanical vectors in *RHDV* infections (Barratt et al., 1998).

Rabbit's environment risk factors for RHD/EBHS emergence or re-emergence mean to be the amount of sources of virus in the area: number of infected host animals, number of passive carriers: insects, rodents, birds and other animals (the viruses can spread by direct and indirect contact).

CONCLUSIONS

The emergence/re-emergence of RHD and EBHS in European countries may occur if the receptive rabbit/hare population will grow into an area with poor/no surveillance/monitoring program of lagomorphs' *Caliciviruses* and a high density of passive carriers.

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